

***Urticina mcpeakii*, a new species of sea anemone
(Anthozoa: Actiniaria: Actiniidae)
from the North American Pacific coast**

J. Susanne Hauswaldt and Katherine E. Pearson

The University of Kansas Natural History Museum and Biodiversity Research Center and
Department of Ecology and Evolutionary Biology, The University of Kansas,
Lawrence, Kansas 66045, U.S.A.

Abstract.—*Urticina mcpeakii*, a new species of sea anemone, is described based on specimens collected from the Coronados Islands, Baja California del Norte, Mexico; Santa Cruz and Anacapa Islands, Channel Islands, California; and Point Loma, California. Mesenteries and tentacles of the new species are arranged hexamerously, rather than decamerously as is typical for other species of *Urticina*. The new species is distinguished externally from other species in the genus by a radial banding pattern on the oral disc, longitudinal striping on the tentacles, and typically debris-covered adhesive verrucae on a bright-red column. We include the first detailed description of the two morphologically different types of microbasic p-mastigophores in the mesenterial filaments. Additionally, size ranges of holotrichs in the tentacle tips are given for the first time for a species in the genus *Urticina*.

Urticina Ehrenberg, 1834 is the most speciose genus of sea anemones on the Pacific coast of North America. Gotshall (1994) recognized five species: *Urticina columbiana* Verrill, 1922; *U. coriacea* (Cuvier, 1798); *U. crassicornis* (Müller, 1776); *U. lofotensis* (Danielssen, 1890); and *U. piscivora* (Sebens & Laakso, 1977). Sebens & Laakso (1977) recognized the same five species under the generic name *Tealia* Gosse, 1858, a junior synonym of *Urticina* (Williams in Manuel, 1981). In addition to these species, Zamponi & Acuña (1996) reported *Urticina asiatica* (Averincev, 1967) and *U. tuberculata* (Cocks, 1851) from Barkley Sound, British Columbia, Canada. On the west coast of North America, the genus *Urticina* ranges from Alaska to Baja California. Within this range, animals occur either in the subtidal or in both the intertidal and subtidal zones (Cutress 1949, Hand 1955, Sebens & Laakso 1977, Gotshall 1994, Zamponi & Acuña 1996). Sea anemones in the genus *Urticina* also occur in the

Northwest Pacific and on both sides of the North Atlantic. Though originally applied to North Atlantic species, the names *U. coriacea*, *U. crassicornis*, and *U. lofotensis* are applied to Northeast Pacific species sensu Hand (1955).

External characters that have been used for distinguishing species in the genus *Urticina* are color pattern and the presence and nature of verrucae on the column (Cutress 1949, Hand 1955, Sebens & Laakso 1977, Gotshall 1994, Zamponi & Acuña 1996). Internal characters include size and distribution of cnidae, number and arrangement of mesenteries, and distribution of fertile mesenteries (Hand 1955, Sebens & Laakso 1977, Zamponi & Acuña 1996).

Materials and Methods

Divers collected nine animals in September 1995 at 25 m from 1.85 km southeast of the tip of South Coronado Island, the Coronados Islands, Baja California del Norte,

Mexico. Ten animals were collected in May 1997 from Point Loma, San Diego, California at 15 m. Animals were held in tanks for observation before relaxation with magnesium sulfate and fixation with 10% formalin. Five museum specimens from the California Academy of Sciences Department of Invertebrate Zoology and Geology (CASIZ) were also examined: CASIZ 61487 (two specimens) and 61488 (one specimen) from Santa Cruz Island, Channel Islands, California, and CASIZ 61491 (two specimens) from Anacapa Island, Channel Islands, California.

Undischarged cnidae capsules from the column and structures at the margin, the actinopharynx, mesenterial filaments, and the tips and bases of the outer and inner tentacles were measured from squash preparations at 1000 $\times$ magnification. Cnidae nomenclature follows Mariscal (1974). Display of cnidae data follows Dunn, Chia, & Levine (1980). Histological sections 8 μ m thick were stained with hematoxylin and eosin (Humason 1979). Oocytes were measured following the method of Wedi & Dunn (1983).

Urticina mcpeaki, new species

Figs. 1A, B, 2–5

Pedal disc.—Circular, strongly adhesive. Color bright red; mesenterial insertions visible as darker red radiating lines. Well developed basilar muscles along each mesentery.

Column.—Bright red with many small, white, adhesive verrucae. Verrucae usually heavily encrusted with debris (Fig. 1A) and arranged in longitudinal rows corresponding to endocoels and exocoels. No verrucae on limbus. Well developed margin and fosse. Distinct round marginal structures; in life yellow, with dark-colored depression in center (Figs. 1A and 2A). Histology (Fig. 2B) and cnidae complement of marginal structures is not distinct from rest of column. When expanded, column generally wider than tall. Maximum size of animals

smaller than other species in genus found in Northeast Pacific; not larger than 5–6 cm pedal disc diameter when expanded. Height generally not greater than 3–4 cm; oral disc diameter when expanded similar to pedal disc diameter. No cinclides present.

Tentacles.—Long and slender when expanded, short and blunt with longitudinal furrows when contracted. Arrangement hexamerous with up to 5 cycles; in most specimens fifth cycle incomplete. Number of tentacles 68–93. Base color of tentacles in most individuals red; in some pink, tan, or brown. Each tentacle encircled with light-colored band at base. Longitudinal stripe extends upward from band at base 1/2–2/3 length of tentacle on aboral side (Fig. 1A), then broadens, creating chevron shape on oral side (Fig. 1B). In most individuals stripe white; other colors such as orange may occur. Bases of tentacles outlined by dark red bands corresponding to mesenterial insertions (Fig. 1B). Longitudinal muscles strong, mesoectodermal; circular muscles weak, endodermal (Fig. 3).

Oral disc.—Color in most individuals red; in some orange or pink. Mesenterial insertions clearly visible. Broad, tentacle-free region around mouth, usually white or light olive green, gives way to distinctive radial banding pattern, such that 12 thick bands extend outward to spaces between first two cycles of tentacles (Fig. 1B). Actinopharynx red, ribbed, with 2 red siphonoglyphs. Radial muscles strong, mesoectodermal.

Mesenteries and internal anatomy.—Mesenteries arranged hexamerously in 4 cycles. Fourth cycle usually incomplete; fourth cycle mesenteries added in exocoels between first and third cycles first, then between second and third cycles. Typical arrangement from half of an animal, directive to directive: D 4 3 2 3 4 1 4 3 2 4 3 4 1 4 3 2 3 4 D. Number of mesentery pairs 29–44; one irregular individual with 52 pairs. Number of mesenteries same proximally and distally. Two pairs of directive mesenteries attached to siphonoglyphs. First and

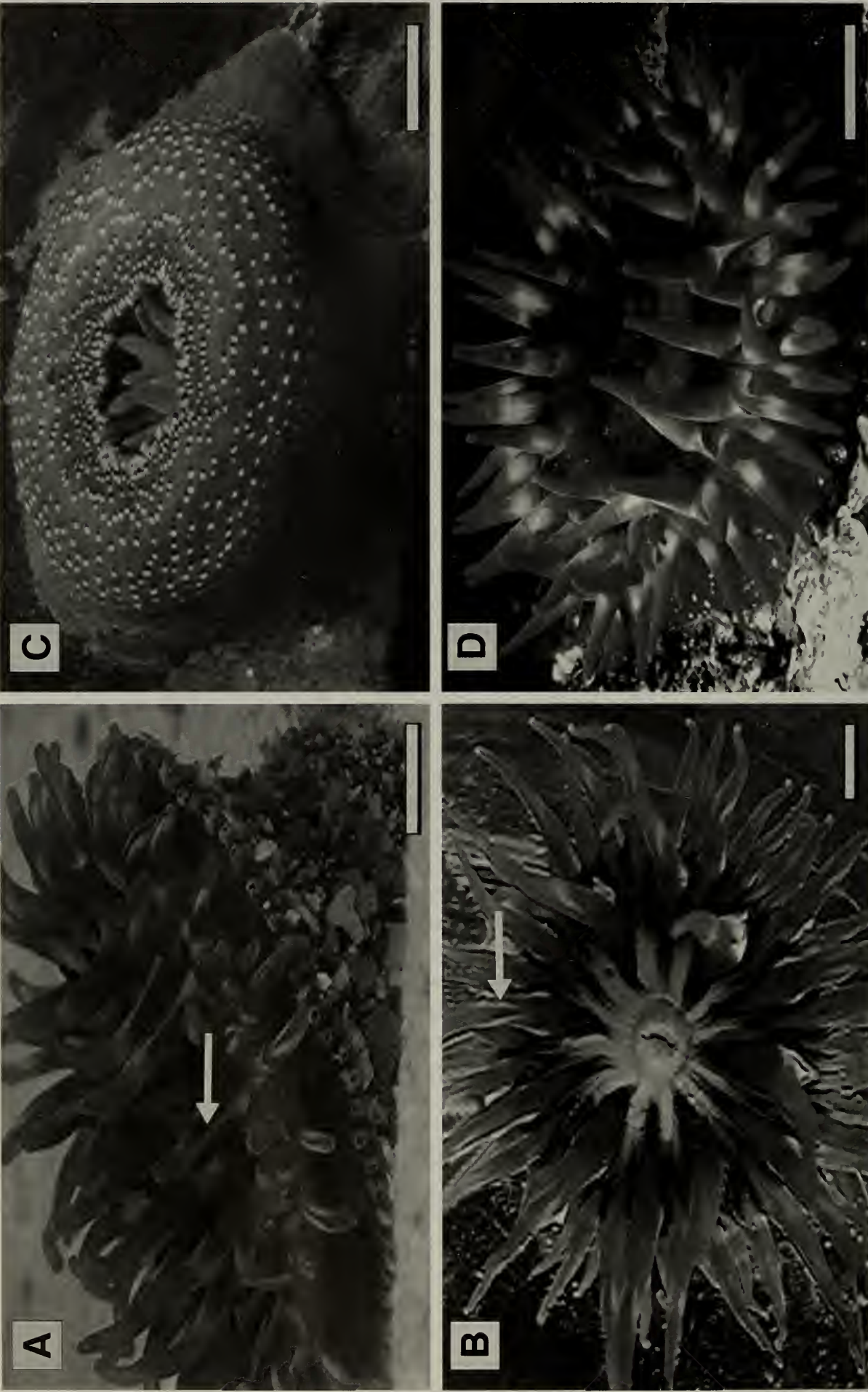


Fig. 1. A and B, *Urricina mcpeaki*, new species. A, lateral view showing longitudinal stripes on tentacles (arrow), structures on margin, and debris attached to column. Scale bar = 1 cm. B, oral disc view showing hexameral banding pattern on disc and chevron shape on tentacles (arrow). Scale bar = 1 cm. C and D, *U. lofotensis* (Danielssen, 1890). C, oral disc view showing white verrucae on column. Scale bar = 2 cm. D, oral disc view showing pattern of tentacles. Scale bar = 3 cm. Photo D by Neil McDaniel.

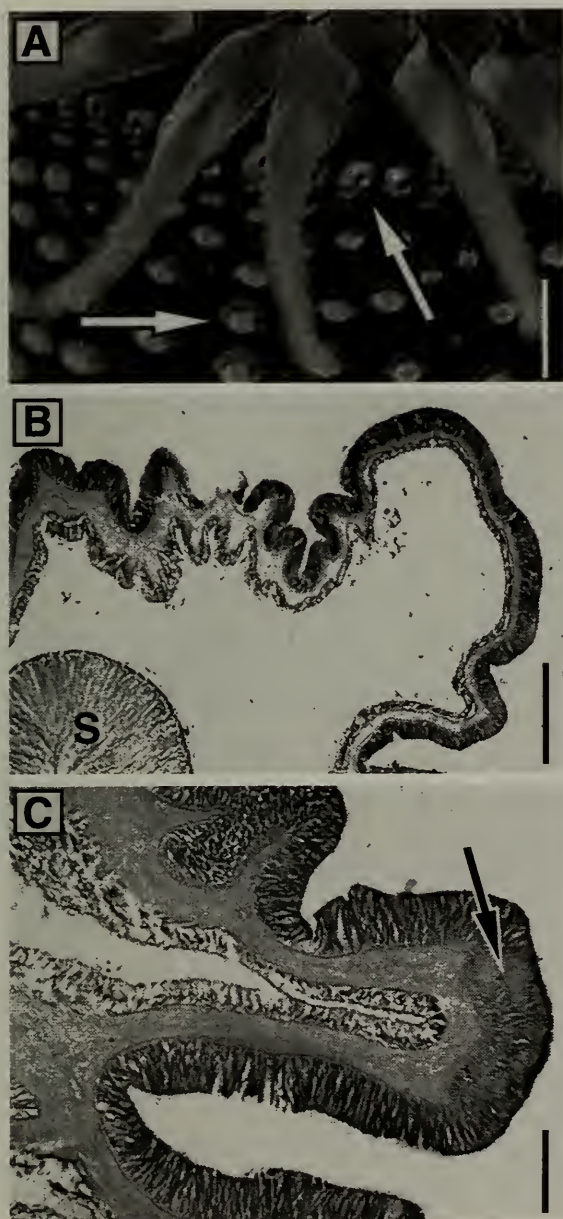


Fig. 2. *Urticina mcpeaki*, new species. A, View of column showing marginal structures (slanted arrow) and verrucae (horizontal arrow). Scale bar = 1.5 cm. B, Histological section showing marginal structure and sphincter (s). Scale bar = 0.2 mm. C, Histological section showing verrucae with modified glandular ectoderm (arrow). Scale bar = 0.2 mm.

second cycles perfect. First cycle sterile; all subsequent cycles may bear gametogenic tissue. Sexes separate. Maximum diameter of ripe oocytes in section approximately 450 μm . Retractor muscles strong, diffuse to restricted (Fig. 4). Parietobasilar muscles well developed and extending from half to entire distance from column to retractor muscle, terminating in free flap (Fig. 4). Marginal stomata present; oral stomata not seen.

Endodermal marginal sphincter muscle circumscribed, large, strong; circular to oval in shape (Fig. 3) and attached to column wall roughly halfway between fosse and parapet. Laminae arranged pinnately and of equal length on both sides of lamella.

Cnidom.—Spirocysts, basitrichs, holotrichs, and microbasic p-mastigophores (two types).

Distribution and size of nematocysts and spirocysts.—In the following table, n signifies the number of individual capsules measured, N signifies the ratio of the number of specimens in which a type of cnida was found to the number of specimens examined, and measurements in parentheses indicate individual capsules that fell outside the range.

Tentacles (tip and base of inner and outer):

Spirocysts (Fig. 5A) $12.5\text{--}39.9 \times 1.4\text{--}4.4 \mu\text{m}$; $n = 528$, $N = 15/15$

Basitrichs (Fig. 5B) $6.5\text{--}32.3 \times 1.1\text{--}4.8 \mu\text{m}$; $n = 709$, $N = 15/15$

Holotrichs (Fig. 5C) (found only in tips, particularly of outer tentacles) $13.8\text{--}23.3 \times 2.9\text{--}4.9 \mu\text{m}$; $n = 111$, $N = 11/15$

Column, including margin:

Basitrichs (Fig. 5B) $4.5\text{--}9.2 \times 1.0\text{--}2.5 \mu\text{m}$; $n = 46$, $N = 10/11$

Basitrichs (Fig. 5B) $13.4\text{--}23.1$ (35.4) $\times 1.5\text{--}4.6 \mu\text{m}$; $n = 152$, $N = 11/11$

Actinopharynx:

Basitrichs (Fig. 5D) $19.2\text{--}38.9 \times 2.5\text{--}6.0 \mu\text{m}$; $n = 245$, $N = 14/14$

Microbasic p-mastigophores type I (Fig. 5E) $16.5\text{--}29.2 \times 4.0\text{--}7.6 \mu\text{m}$; $n = 64$, $N = 8/14$

Mesenterial filaments:

Basitrichs (Fig. 5B) $11.5\text{--}29.8$ (34.4, 36.2) $\times 1.9\text{--}4.1 \mu\text{m}$; $n = 207$, $N = 11/11$

Microbasic p-mastigophores type I (Fig. 5E) $11.7\text{--}30.3$ (33.1) $\times 3.5\text{--}6.8 \mu\text{m}$; $n = 122$, $N = 11/11$



Fig. 3. *Urticina mcpeaki*, new species. Histological section showing sphincter muscle and cross section of tentacle. Scale bar = 0.25 mm.

Microbasic p-mastigophores type II
(Fig. 5F) $19.8\text{--}42.9 \times 3.6\text{--}8.6 \mu\text{m}$;
 $n = 113$, $N = 11/11$
Distribution.—From Santa Barbara, Cal-

ifornia, south at least to Asuncion, Baja
California, Mexico.
Habitat.—Subtidal, in shallow debris-
filled depressions of rocks.



Fig. 4. *Urticina mcpeaki*, new species. Histological section showing oocytes and three pairs of mesenteries with retractor muscles and parietobasilar muscles. Scale bar = 1 mm.

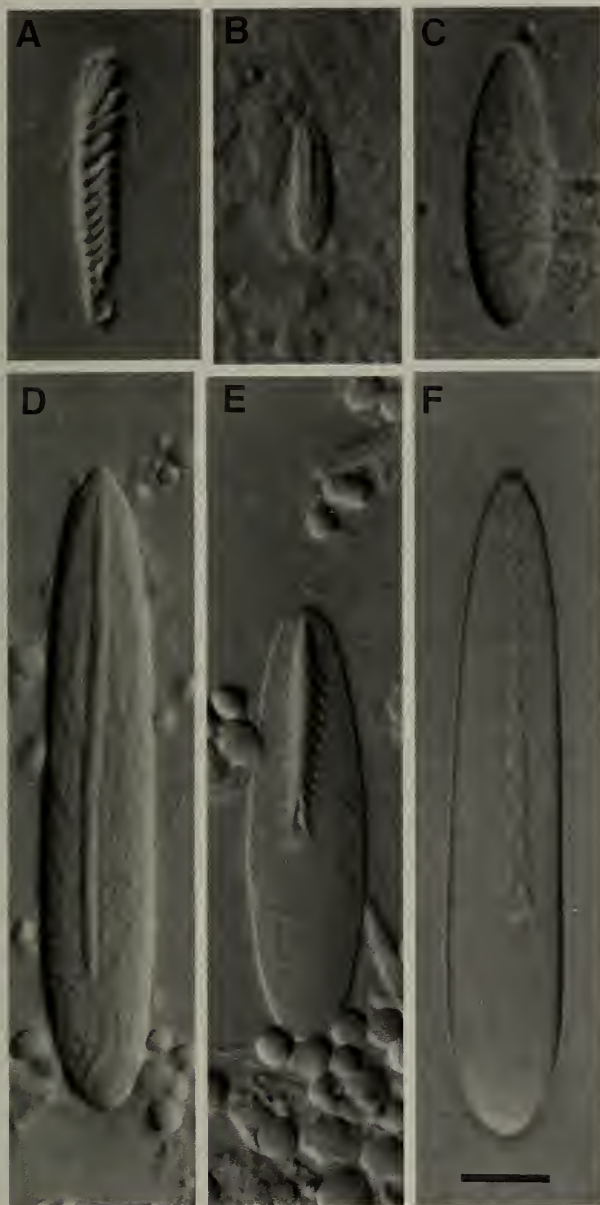


Fig. 5. *Urticina mcpeaki*, new species. Cnidae signature. See text for explanation. Scale bar = 5 μ m.

Type material and locality.—Holotype collected May 1997 from Point Loma, San Diego, California at 15 m; deposited at the CASIZ 114595. Histological slides of specimen also deposited.

Paratypes from type locality CASIZ 114596 and 114597, Santa Barbara Museum of Natural History (SBMNH) 145138 and 145139, University of Kansas Natural History Museum (KUNHM) 001041, National Museum of Natural History (NMNH) 99971 and 99972, and Royal British Columbia Museum (RBCM) 998-221-1. Paratype from the Coronados Islands also deposited at RBCM 998-222-1. Additional

specimens examined deposited at KUNHM 001038, 001162 through 001168.

Etymology.—The specific epithet *mcpeaki* honors Mr. Ron McPeak, who first noticed this species in 1958 and suspected it was a new species of *Urticina*. He provided many of the specimens examined.

Discussion and Differential Diagnosis

Urticina mcpeaki, new species, fits the generic description of *Tealia* (= *Urticina*) sensu Carlgren (1949). It is an actiniid with a well-developed pedal disc, adhesive verrucae on the column, and a well-developed fosse. It has a strong, circumscribed, endodermal sphincter, and the longitudinal musculature of the tentacles and radial musculature of the oral disc are mesoectodermal. The basitrichs of the actinopharynx are larger than those of the tentacles.

The major morphological difference between *U. mcpeaki* and other species in this genus is that mesenteries and tentacles of the first three cycles are always arranged hexamerously. Mesenteries in the fourth cycle are not added simultaneously, resulting in a break of the hexamerous pattern. In other species of *Urticina*, mesenteries and tentacles are usually arranged decamerously (Carlgren 1893, 1921, 1949; Hand 1955, Sebens & Laakso 1977, Manuel 1981). Hexametry in *U. mcpeaki* is unusual, but it is not unique within *Urticina*. Several authors (e.g., Carlgren 1902, 1949; Sebens & Laakso 1977, Zamponi & Acuña 1996) refer to specimens of *Urticina* in which the arrangement of either the mesenteries or the tentacles is not strictly decamerous, but rather hexamerous.

The new species can also be distinguished from other species in this genus by its geographic range. *Urticina mcpeaki* occurs as far north as Santa Barbara, California (Jack Engle, Ron McPeak, pers. comm.). The geographic ranges of all other species of *Urticina* on the west coast of North America extend at least as far north as Vancouver Island, British Columbia,

Canada. Most species are found as far north as Alaska (Gotshall 1994). The range of *U. mcpeakii* overlaps with the ranges of *U. columbiana*, *U. coriacea*, *U. lofotensis*, and *U. piscivora* (Ron McPeak, pers. comm.).

Of all species of *Urticina* on the North American Pacific coast, *U. mcpeakii* most closely resembles *U. lofotensis* externally. Both species have a bright red column with distinct white verrucae arranged in longitudinal rows. However, *U. mcpeakii* can be distinguished externally from *U. lofotensis* by the color pattern of the tentacles and oral disc. *Urticina mcpeakii* has a distinct longitudinal stripe on the otherwise uniformly colored tentacles (Fig. 1A). *Urticina lofotensis* does not have stripes on the tentacles and the color changes from yellow at the base to red at the tip (Fig. 1D). In *U. mcpeakii*, the oral disc has a distinct radial banding pattern (Fig. 1B), while the oral disc of *U. lofotensis* lacks this pattern (Fig. 1D).

The structures at the margin of *U. mcpeakii* differ from those of *U. lofotensis*. In *U. mcpeakii* they are yellow and have a dark-colored depression in the center (Figs. 1A and 2A). The structures in *U. lofotensis* are white and do not differ in appearance from the verrucae on the column (Fig. 1C). Histologically the marginal structures in both species differ from verrucae. Verrucae, sensu Carlgren (1949), have modified ectoderm (e.g., Fig. 2C), which is lacking in the marginal structures. The distinct marginal structures of *U. mcpeakii* may be confused externally with other marginal specializations such as spherules or pseudospherules. However, they do not fit the definition of marginal spherules or pseudospherules, sensu Carlgren (1949), because they have no distinctive histology (Fig. 2B) or cnidae.

The verrucae of *U. mcpeakii* usually have debris attached to them (Fig. 1A). Although the verrucae of *U. lofotensis* are capable of attaching debris (pers. observation), specimens are usually found with no debris attached (Fig. 1C). In *U. mcpeakii*, verrucae

are absent from the limbus. In *U. lofotensis*, verrucae extend to the limbus where they are smaller and closer together than the verrucae of the column.

Lastly, the two species differ in size. The pedal disc diameter in the largest specimens of *U. mcpeakii* is 6 cm, while in *U. lofotensis* it can reach to 18 cm (Sebens & Laakso 1977).

This is the first detailed description of the two types of microbasic p-mastigophores found in the mesenterial filaments. Microbasic p-mastigophore type I (Fig. 5E) is more oval than type II (Fig. 5F) and has pronounced serrations all along its robust shaft. Cnidae of type II are usually larger than those of type I; however, there is some overlap in size within individuals. Type II are more slender than type I, in proportion to their lengths, and the serrations of the shaft are not as distinct. In a few individuals, small numbers of microbasic p-mastigophores type I were also found in other tissues (column, actinopharynx, and tentacle base). These capsules were considered contaminations of those tissues. Microbasic p-mastigophore type II were found only in the mesenterial filaments. We have subsequently found both types of microbasic p-mastigophores in *U. columbiana*, *U. coriacea*, *U. crassicornis*, *U. lofotensis*, and *U. piscivora* from the Northeast Pacific. In his monograph on sea anemones of central California, Hand (1955) included line drawings of the two types of microbasic p-mastigophores he found in the mesenterial filaments of *Tealia crassicornis* (p. 74) and *T. lofotensis* (p. 85) and the one type he found in *T. coriacea* (p. 81). He did not describe the differences between the two types. Our type I corresponds to Hand's line drawing labeled "g" for *T. crassicornis* and *T. lofotensis*, and "k" for *T. coriacea*. Our type II corresponds to Hand's line drawing labeled "h" for *T. crassicornis* and *T. lofotensis*.

This is also the first description of a species of *Urticina* that includes a size range for tentacle holotrichs. In their report of

several species of *Urticina* from British Columbia, Zamponi & Acuña (1996) did not give sizes and probably identified the type of cnidae we term holotrichs as atrichs. Holotrichs have armature along the entire tubule, as opposed to atrichs, which have no armature (Weill 1930). If the spines are very fine, holotrichs can be confused with atrichs (Cutress 1955). As Bigger (1976, 1982) pointed out, atrichs and holotrichs have been confused repeatedly throughout the literature. Sebens & Laakso (1977) mentioned a personal communication with C. Hand regarding the size of holotrichs found in the tentacle tips of several species of *Tealia*. The holotrichs were reportedly larger than other nematocysts in the tentacle tips. We found in *U. mcpeakii* that holotrichs overlap in size with the basitrichs and are never larger. Preliminary data suggest this is also true for *U. coriacea*, *U. crassicornis*, and *U. lofotensis* from the Northeast Pacific.

Acknowledgments

This work was funded by National Science Foundation grant #DEB95-21819 (PEET) awarded to Dr. Daphne G. Fautin, University of Kansas. We are grateful to Dr. Fautin for valuable suggestions and discussions of this work and for reviewing this manuscript. We thank the following people: Ron McPeak, research associate of the Santa Barbara Museum of Natural History, and currently of Global Biological Consultants, Battle Ground, Washington, for specimens, distribution and natural history data, and for reviewing the manuscript; Constance Gramlich of San Diego State University for specimens and for hospitality; Dr. Jack Engle of the Marine Science Institute at the University of California, Santa Barbara, and the Tatman Foundation Channel Islands Research Program, for supplying distribution data; M. en C. Gustavo Hernández Carmona of the Instituto Politecnico Nacional, Mexico for help with the collections in Mexico; and Dr. C. Hand of Bodega Marine

Laboratory for helpful comments on the manuscript. Order of authorship was determined by coin toss.

Literature Cited

- Averincev, V. G. 1967. New species of Actinia (Coelenterate, Anthozoa) from Kuril Islands.—Trudy Zoologicheskogo Instituta Leningrad, Akademiyi Nauk SSSR 43:53–58.
- Bigger, C. H. 1976. The acrorhagial response in *Anthopleura krebbsi*: Intraspecific and interspecific recognition. Pp. 127–136 in G. O. Mackie, ed., Coelenterate ecology and behavior. Plenum Press, New York, 744 pp.
- . 1982. The cellular basis of the aggressive acrorhagial response of sea anemones.—Journal of Morphology 173:259–278.
- Carlgren, O. 1893. Studien über Nordische Actinien. I.—Kungliga Svenska Vetenskaps Akademiens Handlingar 25(10):1–148.
- . 1902. Die Actiniarien der Olga-Expedition.—Wissenschaftliche Meeresuntersuchungen, Abteilung Helgoland 5(1):33–56.
- . 1921. Actiniaria I.—Danish Ingolf-Expedition 5(9):1–121.
- . 1949. A survey of the Ptychodactiaria, Corallimorpharia and Actiniaria.—Kungliga Svenska Vetenskaps Akademiens Handlingar Series 4, 1(1):1–121.
- Cocks, W. P. 1851. Actiniae (or sea anemones), procured in Falmouth and its neighbourhood, by W. P. Cocks, Esq., from 1843 to 1849.—Annual Report of the Royal Cornwall Polytechnic Society 19:3–11.
- Cutress, C. E. 1949. The Oregon shore anemones (Anthozoa). Unpublished Ma. thesis, Oregon State College, 71 pp.
- . 1955. An interpretation of the structure and distribution of cnidae in Anthozoa.—Systematic Zoology 4:120–137.
- Cuvier, G. 1798. Zoophytes. Pp. 650–683 in Tableau elementaire de l'histoire naturelle des animaux. Baudouin, Paris.
- Danielssen, D. C. 1890. Actinida. The Norwegian North-Atlantic Expedition 1876–1878. Grøndahl and Søn, Christiania, 184 pp.
- Dunn, D. F., F.-S. Chia, & R. Levine. 1980. Nomenclature of *Aulactinia* (= *Bunodactis*), with description of *Aulactinia incubans* n. sp. (Coelenterata: Actiniaria), an internally brooding sea anemone from Puget Sound.—Canadian Journal of Zoology 58(11):2071–2080.
- Ehrenberg, C. G. 1834. Beiträge zur physiologischen Kenntniss der Corallenthiere im allgemeinen, und besonders des Rothen Meeres, nebst einem Versuche zur physiologischen Systematik der-

- selben.—Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin 1:225–380.
- Gosse, P. H. 1858. Synopsis of the families, genera, and species of the British Actiniae.—Annals and Magazine of Natural History 3(1):414–419.
- Gotshall, D. W. 1994. Guide to marine invertebrates: Alaska to Baja California. Sea Challengers, Monterey, 105 pp.
- Hand, C. 1955. The sea anemones of central California part II. The endomyarian and mesomyarian anemones.—Wasmann Journal of Biology 13(1):37–99.
- Humason, G. L. 1979. Animal tissue techniques, 4th edition. Freeman and Company, San Francisco, 661 pp.
- Manuel, R. L. 1981. British Anthozoa. Keys and notes for the identification of the species. Synopses of the British Fauna No. 18. Academic Press, London, 241 pp.
- Mariscal, R. N. 1974. Nematocysts. Pp. 129–178 in L. Muscatine and H. M. Lenhoff, eds., Coelenterate biology: reviews and new perspectives. Academic Press, New York.
- Müller, O. F. 1776. Zoologiae danicae prodromus, seu animalium daniae et norvegiae indigenarum characteres, nomina, et synonyma imprimis popularium. Hallageriis, Havniae, 274 pp.
- Sebens, K. P., & G. Laakso. 1977. The genus *Tealia* (Anthozoa: Actiniaria) in the waters of the San Juan Archipelago and the Olympic Peninsula.—Wasmann Journal of Biology 35(2):152–168.
- Verrill, A. E. 1922. The Actiniaria of the Canadian Arctic expeditions, with notes on interesting species from Hudson Bay and other Canadian localities.—Report of the Canadian Arctic Expedition 1913–1918 8(G):89–164.
- Wedi, S. E., & D. F. Dunn. 1983. Gametogenesis and reproductive periodicity of the subtidal sea anemone *Urticina lofotensis* (Coelenterata: Actiniaria) in California.—Biological Bulletin 165:458–472.
- Weill, R. 1930. Essai d'une classification des nématocystes, des Cnidaires.—Bulletin Biologique de France et Belgique 64:141–153.
- Zamponi, M. O., & F. H. Acuña. 1996. El genero *Urticina* (= *Tealia*) Ehrenberg, 1834 (Actiniaria) de Barkley Sound (Canada).—Physis Secc. A, 52 (122–123):1–12.